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TWO-PIECE CENTER WIRE SPARK PLUG

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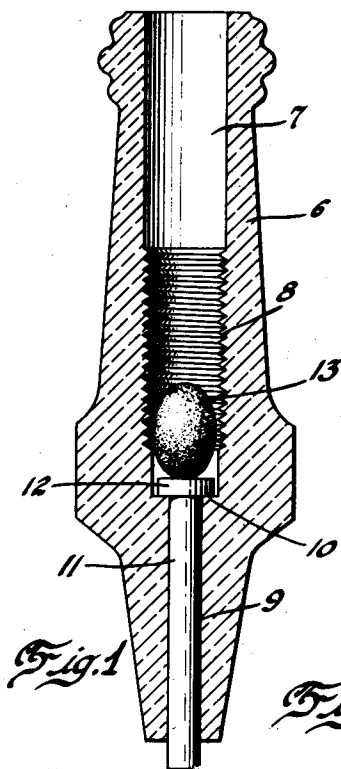


Fig. 1

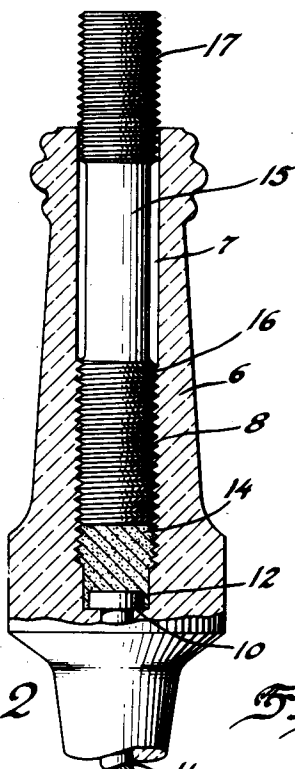


Fig. 2

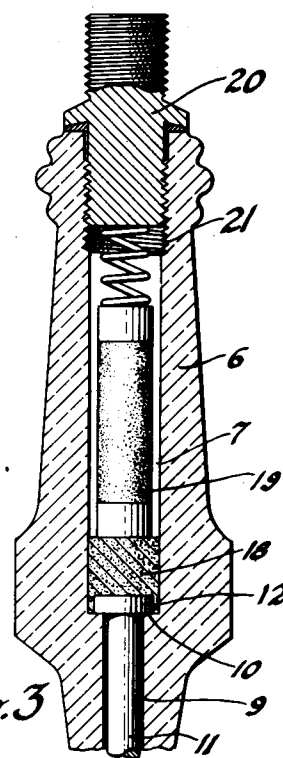


Fig. 3

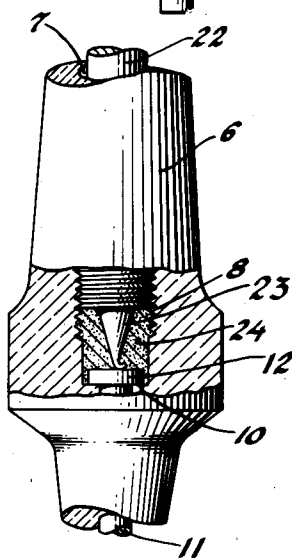


Fig. 4

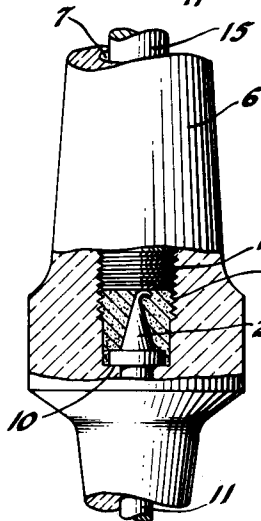


Fig. 5

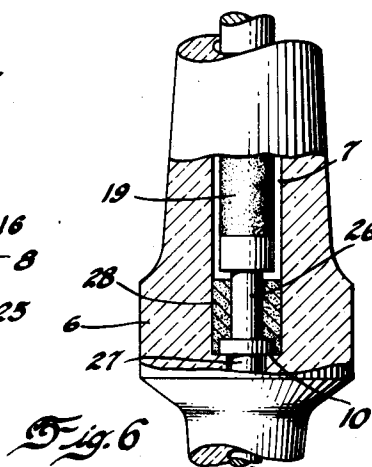


Fig. 6

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TWO-PIECE CENTER WIRE SPARK PLUG

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13 Claims. (Cl. 123-169)

Our invention relates to two-piece insulated electrodes for spark plugs of the type wherein the central electrode is made up of an inner part which extends from a supporting ledge within a passage extending longitudinally through the insulating member of the plug, and through which the electrode extends, and which ledge is located adjacent the central part of said insulating member, beyond the inner end of said member to provide a spark gap; and a second outer part within said passage and extending beyond the outer exposed end of said insulating member to provide a terminal for connecting a supply cable to the plug; the upper end of said inner part being sealed gas-tight within said passage, and provision being made whereby a conducting path is provided between said electrode parts which together form a two-part insulated electrode of a spark plug. The object of our invention is to secure more perfect sealing at the upper end of the lower electrode part whereby leakage of gas along the electrode is more effectively prevented.

The drawing accompanying and forming a part of this application illustrates our invention in its preferred form, and the particular features wherein the same consists are particularly pointed out in the claims at the end of this specification.

In the drawing:

Figure 1 is a view showing an insulating member of a spark plug upon a longitudinally extending central plane, and illustrating the first step in the formation of a seal in accordance with our invention.

Figure 2 is a similar view showing a two-piece electrode assembled and sealed within the passage in the insulating member through which it extends.

Figure 3 is a sectional view similar to Figure 2 showing our invention applied to a radio spark plug.

Figures 4, 5 and 6 are fragmentary views showing our invention modified as to certain features thereof.

Referring now to the drawing, the numeral 6 designates a conventional form of the insulating member of a spark plug, made of porcelain or equivalent ceramic material, and which member has a longitudinally extending passage through which the central electrode of the plug extends. This passage has a larger upper part 7 which is shown as internally threaded at 8, and a smaller lower part 9; the passages merging with one another near the central part of the insulating member where, and due to the difference in their

diameters, an internal supporting ledge 10 is provided.

The numeral 11 designates the inner of the parts which together form a two-piece insulated electrode of a spark plug, the same fitting closely within the passage 9 but not being cemented therein, so that said part is free to expand and contract due to temperature variations therein and in the insulating member. The upper end of this part has an enlarged head 12 which rests upon the ledge 10 as shown; and a washer of soft metal, such as copper, or of asbestos or asbestos encased in a copper sheath, may if deemed necessary be interposed between the head 12 and the ledge 10.

In providing a seal at the upper end of the lower electrode part, referring particularly to Figures 1 and 2, the part 11 is put in place, as shown in Figure 1, and then a mass of plastic material 13 of about the consistency of putty, and shaped more or less into the form of a pellet, is dropped into the passage 7 and rests upon the head 12. This pellet is then pressed or tamped to cause it to fill the lower end of said passage and form intimate contact with the interior of the lower end thereof, and with and about the head 12, as indicated at 14 in Figure 2.

The upper or outer part 15 of the two-piece electrode, which is threaded at 16 to form an interlocking connection with the interiorly threaded part 8 of the larger passage 7, is next screwed into said passage and into firm engagement with the plastic material 14; which as will be appreciated now fills the interstices between the adjacent electrode parts and the interior of the passage 7 at its lower or inner end, and is pressed into intimate engagement with the head 12 and the walls of the space wherein it is confined. The outer end of the upper electrode part is shown as threaded, at 17, so that a supply cable may be connected thereto.

In the application of our invention to a spark plug having means for suppressing high frequency oscillations (which interfere with adjacent radio apparatus) as illustrated in Figure 3, an equivalent pellet of plastic material is pressed or tamped within the lower end of the larger passage 7 above and about the head 12 to form a seal, as indicated at 18; and a high resistance element 19 is interposed between said seal and the inner end of an outer electrode part 20, the inner portion of which is threaded to engage an internally threaded part 21 of the enlarged passage 7; the purpose of this resistance member being to suppress high frequency oscillations emanating from the electrode.

nating from the high tension current supplied to the spark plug.

The plastic material is made from a liquid binder in which an inert ingredient is incorporated to impart consistency thereto, said binder being characterized in that when heated it will harden and become solid without access of air thereto, and without the liberation of gas or volatile products as an incident to such hardening process due, as we understand, to decomposition of the binding material itself or of an ingredient thereof. The inert material has nothing to do with the hardening, when heated, of the liquid constituent of the plastic mass, its use being as a filler to impart consistency to the mass so that it may be shaped into pellet or like form and distorted to fill the space wherein it is contained, as above explained. The insulating member 6 with the electrode parts assembled therewith, as in Figure 2, or with the inner electrode part sealed in place as in Figure 3, may be heated to accomplish the hardening and solidification of the binder before the insulated member is assembled with the shell or casing of a spark plug; or the completed plug may be put into use before the binder has hardened to form a solid mass, in which case such hardening will occur as soon as the plug becomes heated when it is in use with an engine. The plastic material 14 as a matter of course provides a gas-tight seal before it is subjected to the heating step; but setting and hardening of the liquid binder and conversion of the plastic mass into a solid sealing member whereby it becomes in effect a part of the insulating member itself, is dependent upon heating and does not occur until the same is heated; either initially and before the insulator and electrode parts are assembled within a spark plug casing, or after the plug has been finished and during the initial period of its use with an engine.

The hardening when subjected to heat, without the liberation of vapors or gases, of the liquid binding ingredient of the sealing material, is a property or characteristic of certain vegetable oils and is commonly referred to as "polymerization" of such oils. This property is especially pronounced in tung or China-wood oil, and that is the binding material with which we have secured the best results in providing a seal in accordance with our invention; as a mass of plastic material made up of such a binding material and an inert filling material will, when heated, harden and form a dense mass which adheres tenaciously to the wall of the space or chamber wherein it is confined and secure gas tightness at the seal; the hardening and solidification of the mass being accompanied by no liberation of gaseous products within said space.

We have also secured successful sealing in accordance with our invention using perilla oil, linseed oil, rapeseed oil, and similar vegetable oils of the class commonly referred to as drying oils, as liquid binding materials, which oils are supposed to dry and harden mainly if not wholly by absorbing oxygen from the surrounding atmosphere, rather than by the effect of heat and without access of air to them. These last-named oils, however, contain ingredients which interfere with the hardening when heated, and without the liberation of a gas or vapor, of a plastic mass whereof they comprise the liquid binding material; but we have secured satisfactory results (using such oils as liquid binding materials) by adding sulphur monochloride to them to the ex-

tent of about 15% of the amount of the oil used; so that such oils when so treated may be used in place of tung or China-wood oil which requires no added ingredient to adapt it for use in performing our invention.

The inert materials mixed with the binding oils may be of various kinds, as they act as fillers and do not enter into the setting and hardening process of the plastic mass under the influence of heat as hereinbefore explained; and we have used talc, French chalk, litharge, clay, lampblack, granular graphite, copper and other metals in powdered form as inert materials with success; although we regard tung or China-wood oil and graphite as the best composition to use for the sealing material. When such materials as lampblack, graphite, granular copper, etc. are used, the seal formed is conductive of electricity to various degrees, and such materials are recommended in the forms of our invention illustrated in Figures 2 and 3; whereas when the other materials enumerated or their equivalents are used our invention is usually modified as illustrated in Figures 4, 5 and 6 to be hereinafter described.

It follows that the electrical resistance of the sealing material varies throughout a wide range. If a powdered metal, or graphite, or if lampblack is used as a filler, then the resistance of an electrode, including that of the sealing material, of the form shown in Figures 2 and 3 will not be high enough to be objectionable; and in all cases and even though the resistance at the seal may be higher than is desirable the initial flow of high tension current will ionize the sealing material and establish a conducting path of comparatively low resistance which will persist during the subsequent operation of the plug.

When, however, the sealing material after being heated to secure the hardening thereof may be of greater resistance, electrically, than is desirable, a conducting path may be provided between the lower and upper parts of the two-part electrode. Thus Figure 4 shows the upper electrode part 22 as having a prong 23 at its inner end; and when such a form of upper electrode part is screwed into the threaded passage 7 in the insulating member said prong pierces the plastic sealing mass 24 and its extremity engages the head 12 and is curled over as shown, thus establishing a metallic conducting path between the parts 22 and 11 of the central electrode. As an obvious variation the lower electrode part may have a prong 25 upon its head, as shown in Figure 5, in which case the lower end of the upper part 15 engages the extremity thereof and curls it over as shown. In either case the prong yields until the plastic sealing material is forced into intimate contact with the inner wall of the space wherein it is enclosed, thus securing gas tightness and at the same time establishing a conducting path between adjacent ends of the two-piece central electrode.

The prong is preferably provided upon the upper one of the electrode parts, as in Figure 4, because it is ordinarily made of a softer and more easily machined material, and of a cheaper material than the lower part; and because the plastic material pellet 13 may be more readily compressed and tamped within the lower end of the passage 7 and about the head 12 if said head has no projection like the prong 25 extending upward therefrom.

The projection or "prong" may, however, be cylindrical in form as shown at 26 in Figure 6 wherein it extends from the upper end of the

lower electrode part 27, and is surrounded by sealing material 28; this form being preferable when a high resistance element 19 is incorporated in the plug structure to prevent the ignition circuit from interfering with adjacent radio apparatus, as in so-called radio spark plugs; as in such cases the upper end of the projection provides a convenient support for the high resistance member. Such a projection, however, may be used in the forms of our invention illustrated in Figures 4 and 5 in which case the lower electrode part is pressed and held against the seat 10 with more force during the assembling of the parts within the passage in the insulating member, and is more securely held in place because of the greater area of contact provided by the cylindrical as distinguished from the conical projection, than when the tapered and yieldable pointed form of prong is used. The sealing material 18 in Figure 20 3 has enough graphite or granular metal in its composition to make it a sufficiently good conductor; and the projection, whether conical or cylindrical in form, may extend from either the upper or the lower of the electrode parts as illustrated in Figures 4 and 5.

In order to bring about setting and solidification of the plastic sealing mixture whereby sealing of the central electrode is accomplished the same is heated to a temperature around 250° C. for a period of about ten minutes; during which the plastic composition sets and hardens with an accompanying slight expansion, thus securing complete and certain gas tightness in the completed plug. This heating as explained is preferably of the insulating member after the central electrode has been assembled therewith, and before the member has been assembled within the shell of a spark plug; but and as explained the plug may be first completely assembled, whereupon and during a short initial period of use complete setting of the plastic mixture will take place.

Having thus described and explained our invention, we claim and desire to secure by Letters Patent:

1. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage and are spaced apart from one another; and a plastic sealing member filling the space between said two ends; said member comprising a liquid vegetable drying oil binder which will harden and become solid when heated, and an inert material incorporated with said binder.

2. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage and are spaced apart from one another; and a plastic sealing member filling the space between said two ends; said member comprising a vegetable oil binder which when heated will polymerize and form a solid mass, and an inert material incorporated with said vegetable oil binder.

3. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage and are spaced apart from one another; and a hardened sealing member filling the space between said two ends and formed by heating a mass of plastic

material made up of a polymerizing vegetable oil and an inert filling material.

4. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage and are spaced apart from one another; and a hardened sealing member filling the space between said two ends and formed by heating a mass of plastic material made up of a polymerizing vegetable oil mixed with an inert filling material having electricity conducting properties.

5. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the parts of which lie within said passage and are spaced apart from one another; and a sealing member filling the space between said two ends; said member comprising a tung or China-wood oil binder and an inert filling material incorporated therewith and hardened by applying heat thereto.

6. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the parts of which lie within said passage and are spaced apart from one another; and a sealing member filling the space between said two ends; said member being composed of a tung or China-wood oil binder and powdered graphite mixed together and hardened by heating said member.

7. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage; and a plastic sealing member filling the space between said two ends; one of the parts of said electrode having a projection which extends through said plastic sealing member and contacts with the other of said electrode parts to establish a conducting path between said parts.

8. In combination with a spark plug insulator having a passage extending therethrough for a central electrode; a two-piece electrode extending through, and adjacent ends of the two parts of which lie within said passage; and a sealing member filling the space between said two ends and formed by heating a plastic mass comprising a polymerizing oil mixed with an inert filling material, to thereby harden said mass; one of the parts of said electrode having a projection which extends through said sealing member and contacts with the other of said electrode parts to establish a conducting path between said parts.

9. In combination with a spark plug insulator having a passage extending therethrough for a central electrode, and a supporting ledge within said passage; an inner electrode part having an enlarged head which rests upon said ledge; and a plastic sealing member within said passage whereby a gas-tight seal is provided adjacent said head; said sealing member comprising a liquid vegetable drying oil binder which will harden and become solid when heated, and an inert material incorporated with said binder.

10. In combination with a spark plug insulator having a passage extending therethrough for a central electrode and a supporting ledge within said passage; an inner electrode part having an enlarged head which rests upon said ledge; and a plastic sealing member within said passage whereby a gas-tight seal is provided adjacent said head; said sealing member comprising a vegetable

oil binder which when heated will polymerize and form a solid mass, and an inert material incorporated with said vegetable oil binder.

11. In combination with a spark plug insulator
 5 having a passage extending therethrough for a central electrode, and a supporting ledge within said passage; an inner electrode part having an enlarged head which rests upon said ledge; and a hardened sealing member within said pas-
 10 sage whereby a gas-tight seal is provided adjacent said head; said sealing member being formed by heating a mass of plastic material made up of a polymerizing vegetable oil and an inert filling material.
12. In combination with a spark plug insulator
 15 having a passage extending therethrough for a central electrode; a central electrode extending through said passage; and a sealing material associated with said electrode and acting to pre-

vent the flow of gas along said passage; said sealing material comprising a vegetable oil binder which when heated will polymerize and form a solid mass, and an inert material incorporated with said vegetable oil binder.

13. In combination with a spark plug insulator
 having a passage extending therethrough for a central electrode; a central electrode extending through said passage; and a sealing material associated with said electrode and acting to pre-
 10 vent the flow of gas along said passage; said sealing material being located at the central part of said electrode, and the same comprising tung or China-wood oil mixed with an inert filling material.

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